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AIR QUALITY SURVEY IN THE SARNIA AREA JULY 1986

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Environment Ontario

Jim Bradley
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AIR QUALITY SURVEY

IN THE

SARNIA AREA

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Prepared by

R.E. Chapman and G.B. DeBrou

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RÉSUMÉ

Trois unités mobiles de surveillance de l'air de la Direction des ressources atmosphériques ont effectué deux études de la qualité de l'air à Sarnia en juillet 1986. L'étude principale avait pour but d'établir les concentrations ambiantes d'un grand nombre de substances susceptibles d'être émises par beaucoup d'industries de la région. L'autre visait à déterminer si des BPC étaient présents dans les émissions produites par l'incinérateur thermique de l'usine de la Dow Chemical, toujours à Sarnia.

Pour faciliter les analyses et par souci de clarté, la région de Sarnia a été divisée en cinq zones. Aucun des polluants courants, comme l'anhydride sulfureux (SO_2), l'oxyde d'azote (NO_2), le monoxyde de carbone (CO), le soufre réduit total (SRT) et l'ozone (O_3), ne dépassait les normes ou lignes directrices de l'Ontario, où que ce soit. C'est dans la zone industrielle de la rue Vidal qu'on a mesuré la concentration la plus élevée, en une demi-heure, de la plupart des substances.

Aucun des composés organiques relevés dans l'air ne dépassait non plus les normes et lignes directrices de la province. Les zones de la rue Vidal, du chemin Indian et de Point Edward sont celles où l'on a constaté la plus forte concentration de composés organiques particuliers, mais la concentration moyenne de la plupart des composés était plus élevée dans le centre-ville de Sarnia, probablement à cause de son emplacement.

Chaque fois que l'analyseur des gaz atmosphériques à l'état de trace a repéré des composés organiques polaires, leur concentration était extrêmement faible.

Pendant trois jours de surveillance aux environs de l'incinérateur thermique, en aucun cas les concentrations de BPC relevées par l'analyseur n'ont-elles dépassé le seuil prescrit par l'Ontario, soit 0,45 $\mu g/m^3$ en une demi-heure. En fait, l'appareil ne peut détecter que des concentrations moyennes de 0,13 $\mu g/m^3$ de BPC, et les concentrations mesurées étaient toujours en dessous de ce chiffre.

Les concentrations moyennes de composés organochlorés totaux que l'unité mobile n° 2 a pu mesurer étaient plus élevées près de l'incinérateur qu'elles ne l'étaient ailleurs à Sarnia, mais les normes et lignes directrices de l'Ontario n'ont pas été dépassées ici non plus.

EXECUTIVE SUMMARY

Three mobile air monitoring units (MAMUs) from the Air Resources Branch performed two air quality studies in the greater Sarnia area in July, 1986. The purpose of the main study was to determine the ambient air concentrations of a large number of compounds which may be emitted from many industries located in Sarnia. The purpose of the secondary study was to determine if PCBs were present in the emissions from the thermal oxidation (TOX) incinerator of the Dow Chemical Inc. plant in Sarnia.

For ease of analysis and comprehension the Sarnia area was split into five zones. None of the common contaminants such as sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), total reduced sulphur (TRS) and ozone (O_3) exceeded their Ontario standards or guidelines in any of the zones during the study. The Vidal Street industrial zone produced the largest 1/2-hour average concentration for most of the compounds.

None of the organic compounds measured in the air exceeded any Ontario standards or guidelines in any of the zones during the study. The Vidal St., Indian Rd., and Point Edward zones produced most of the larger concentrations for any particular organic compound; however, the mean concentration was larger for more compounds in the downtown Sarnia zone than in the other zones, probably due to its centralized location.

On the occasions when polar organic compounds were detected and identified by the mobile TAGA unit the concentrations were extremely low.

During three days of monitoring near the TOX incinerator, none of the PCB measurements by the TAGA system exceeded the Ontario guideline of 0.45 ug/m^3 for a 1/2-hour average. In fact, all of the measurements were below the TAGA's detection limits of 0.13 ug/m^3 (average) for total PCBs.

The mean concentration of the total chlorinated organics measured by MAMU #2 was larger near the TOX incinerator than in the general Sarnia area, but none of the applicable Ontario standards or guidelines were exceeded.

1.0 INTRODUCTION

Two air quality studies were carried out in the greater Sarnia area in July, 1986. The purpose of the main study was to determine the ambient air concentrations of a large number of compounds which may be emitted from many industries located in Sarnia - particularly the southern section along Vidal Street known as "chemical valley". Previous similar studies were done in 1977 and 1978, but the need for more current information was apparent.

Three mobile air monitoring units (MAMUs) from the Air Resources Branch were used to maximize the amount of data obtained during the allotted survey period. Monitored compounds included sulphur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), total reduced sulphur (TRS) including hydrogen sulphide, ozone (O_3), and a large number of organics and chlorinated organics.

The second study monitored the emissions from the thermal oxidation (TOX) incinerator of the Dow Chemical plant, more specifically for polychlorinated biphenyls (PCBs). Section 6 contains the results of the Dow study.

2.0 MOBILE AIR MONITORING UNITS (MAMUS)

The instrumentation packages in MAMU #1 and MAMU #2 are nearly identical (Tables 1 & 2), each including a gas chromatograph (GC) coupled to a volatile organic compounds (VOC's) preconcentrator of the Ministry's design.

The GC systems were calibrated each day by the injection of a known n-alkane mixture of C3 to C12. The instruments for measuring the common contaminants such as SO2 and CO were also calibrated daily through the use of on-board permeation sources, bottled gases or other tested techniques. Both MAMU #1 and MAMU #2 recorded several meteorological parameters while sampling, including wind speed and direction, temperature, relative humidity, barometric pressure and solar radiation.

The MAMU #3 contains a trace atmospheric gas analyzer (TAGA 3000) system, which is a single quadrupole mass spectrometer coupled to an atmospheric-pressure chemical ionization source. The TAGA system is sensitive to most volatile compounds containing a heteroatom, such as N, O, S, P, and halide. Typical detection limits are in the range of 0.1 to 10 ug/m^3 depending on the type of chemical measured and the sample matrix. MAMU #3 is also equipped to measure wind speed, wind direction and temperature.

3.0 SURVEY STRATEGY

The operating strategy was to collect ambient air data at many locations in the Sarnia area, particularly in and around the southern section known as the "chemical valley". MAMU #1 and MAMU #2 frequently operated in unison, with one unit downwind of a suspected source area and the other unit on the upwind side, if possible. The aim of the study was to screen the areas for a large number of compounds and not focus on any particular industry, unless the 30-minute average concentration of any compound exceeded its Ontario standard or guideline. The 30-minute sampling time was used (instead of 60 minutes) so that a much larger data set could be created in the time allotted for the survey.

The MAMU #3 was used to screen the ambient air for the presence of all polar organics detectable by the TAGA 3000 system. For a given monitoring period numerous mass spectra of the ambient air were acquired.

These mass spectra were analyzed later and the concentrations were estimated for a 2-minute monitoring period. Since the pollutant identification was based solely on the interpretation of mass spectra the results are tentative. Also, since the purpose of the survey was to attempt to "fingerprint" the air samples, calibrations were not performed (except for PCBs - section 6.0) at any time during the survey. Thus the pollutant levels were only estimated within a factor of three.

4.0 SAMPLING LOCATIONS AND RESULTS

The sample locations and monitoring periods are listed in Tables 3, 4 and 5 for MAMU #1, #2 and #3. Maps of the area showing approximate locations of monitoring are displayed in Figures 1,2,3 and 4.

4.1 Results for MAMU #1 and MAMU #2

4.1.1 Common Contaminants

A list of the common contaminants monitored in this survey is given in Appendix 1. A summary of the common contaminant data is contained in Table 6 showing the maximum 30-minute average concentrations for five zones in the Sarnia area. Results for upwind periods on the north side of the city (Point Edward) and the south side (south of Suncor) are also shown. The zone boundaries are shown in Figures 1 and 2.

The maximum CO concentration for each zone was in the range of 1.4 to 4.5 ppm, well below the Ontario 1-hr criterion of 30 ppm and below the stationary source 1/2-hr standard of 5.0 ppm.

The maximum TRS concentrations were in the range of 0.002 to 0.030 ppm. There is no kraft pulp mill in the Sarnia area, thus the Ontario 1/2-hr guideline (0.027 ppm) does not apply in this case. If all of the TRS was in the form of hydrogen sulphide (H_2S), then only one period in the study would have exceeded the 1/2-hr standard (0.02 ppm) for H_2S.

The maximum total hydrocarbons (THC) concentrations were in the range of 3.0 to 6.9 ppm. There is no standard, guideline or criterion for THC in Ontario, but there are for many of the components of THC which were measured separately on the gas chromatograph (Section 4.1.2).

The maximum SO_2 concentrations were in the range of 0.08 to 0.27 ppm, which is just below the Ontario 1/2-hr standard of 0.30 ppm.

The maximum NO_2 concentrations were in the range of 0.05 to 0.11 ppm, which were well below the 1-hr criterion of 0.20 ppm. The maximum nitrogen oxides (NO_x) concentration (sum of NO and NO_2) at 0.21 ppm was also less than the Ontario 1/2-hr standard (0.25 ppm).

The maximum ozone concentrations were in the range of 0.05 to 0.10 ppm. The 1/2-hr standard of 0.10 ppm was not exceeded. Nearly one-half of the data was declared invalid because one of the analyzers malfunctioned.

One notable feature of the results is that the Vidal Street industrial zone accounted for the maxima in THC, SO_2 and NO_2, and was probably responsible for the TRS maximum also. Another point to note is that the maximum upwind concentrations (both north and south) were below the maxima in all zones for all compounds except ozone. This indicates that good upwind data were collected and reflects the fact that ozone is not directly due to any particular source.

4.1.2 Organic Compounds

A list of the organic compounds monitored in this survey is given in Appendix 2, and includes the Ontario standards, guidelines and criteria for ambient air that apply to each compound.

Review of the complete results for all of the 30-minute samples analyzed by gas chromatography showed that none of the detected compounds exceeded or approached their standards, guidelines or criteria. The

complete results are not included in this report, but are available upon request from the Air Resources Branch.

Table 7 contains a results summary for 12 of the compounds that are generally of greater concern. From a statistics viewpoint the number of samples is relatively small, but a few comments on some trends are appropriate. No single zone dominated the results; however, Vidal St., Indian Rd. and Point Edward had noticeably more of the top two maxima for each compound than the other two zones or the upwind periods. Vidal St. has many potential sources and the Indian Rd. site is near some large tank farms of organic compounds, but the main influence on Point Edward's air is less obvious. Although the Sarnia zone had few of the maxima, the largest mean value was found for more compounds in Sarnia than in the other zones. This was probably due to the more central location of the Sarnia zone with respect to the other zones, resulting in small but steady contributions from all wind directions.

4.2 Sarnia 1986 - Results and Discussion (TAGA 3000)

The MAMU #3 (TAGA 3000) conducted the survey in the area on July 9, 10, 14, 15, 16, 17, 18, 21 and 22. The survey objective for the TAGA unit was to monitor polar organic compounds in the ambient air downwind of "chemical valley". This objective was achieved through the acquisition of chemical fingerprints of the ambient air at various locations in the area (Refer to Figures 3 and 4 for sampling locations). Each of these fingerprints represents an analysis of several mass spectra collected by the TAGA 3000, an atmospheric pressure, chemical ionization mass spectrometer.

A total of 23 fingerprints was acquired at 17 monitoring locations during the survey. The monitoring sites were chosen so as to exemplify general air quality, not to isolate any particular industrial source. Table 5 summarizes the findings with respect to compounds identified, monitoring periods, meteorological conditions and sampling locations.

The data contained in Table 5 have been background (or upwind) corrected.

As indicated in Table 5, there was a total of seven compounds tentatively identified in the air during this survey: acetone, methanol, ethanol, butanone, pentanone, butylamine and dimethyl disulfide (DMDS). Estimates of the concentrations for these compounds range from 1 to 15 ug/m3. These estimated concentrations are orders of magnitude below any applicable Ministry standard or guideline. As well, it should be noted that for 9 of the 23 monitoring periods the mass spectral information was insufficient to identify any compounds, despite the fact the TAGA 3000 is extremely sensitive to polar organic compounds. (Typical detection limits for compounds containing a heteroatom such as N, O, S, or P range from 0.1 to 10 ug/m3, depending on the type of chemical measured and the sample matrix.) The TAGA 3000 is not sensitive to the more common aliphatic, aromatic, and chlorinated hydrocarbons, all of which are readily detected by the MAMUs #1 and #2.

5.0 SUMMARY OF GENERAL SARNIA SURVEY

None of the common contaminant concentrations in the air exceeded any Ontario standards, guidelines or criteria during the survey. The Vidal Street industrial zone produced the largest 1/2-hour averages for THC, SO_2, and NO_2 (and possibly TRS).

None of the organic compounds exceeded any applicable Ontario standards or guidelines. The largest single measurement for any organic compound should more likely be found in the Vidal St, Indian Rd or Point Edward zones. However, more organic compounds achieved their largest mean concentrations in the downtown Sarnia zone than in the other zones, probably because of its centralized location.

On the occasions when polar organic pollutants were detected and identified by the mobile TAGA unit the concentrations were extremely low. These results are consistent with observations by the field staff,

which indicated that odour episodes were rare at our monitoring locations.

6.0 DOW SURVEY (TOX INCINERATOR)

As requested by the Southwestern Region, the mobile TAGA 3000 unit and MAMU #2 performed an air monitoring survey from July 28 to 30, 1986, at Dow Chemical Incorporated in Sarnia, Ontario. The primary purpose of the survey was to determine if PCBs were present in the emissions from the TOX incinerator. Since the MAMU #2 was already in the Sarnia area, it was used in addition to the TAGA unit for this survey, providing ground level concentrations of selected chlorinated organics. The TOX (total oxidation) incinerator operated by Dow Chemical Inc. is designed to destroy, on-site, chlorinated organic waste products, including chlorinated benzenes and chlorinated phenols.

6.1 Monitoring Techniques and Survey Strategy

6.1.1 MAMU #3 (PCBs)

A detailed description of the PCB monitoring technique can be found in a previous report (ARB-130-87-ARSP). Briefly, the TAGA (model 3000) is a specialized, single quadrupole mass spectrometer with an atmospheric-pressure, chemical ionization (APCI) ion source. When monitoring PCBs the TAGA ion source is coupled to a PCB preconcentrator and thermal desorption device known as the ASTA (Automated Short Term Adsorber).

The TAGA/ASTA technique provides ambient PCB measurements in 2-minute intervals. The 1/2-hour average concentrations are computed by averaging 15 consecutive 2-minute samples. In this study the air was screened for the di-, tri-, tetra-, and pentachlorobiphenyl isomer groups.

Each day, prior to the start of the incineration process, background data were collected. The background data were used to correct the

downwind measurements, and determine the daily detection limits. (The detection limit (DL) is defined as being 3 times the standard deviation of the background or upwind signal, observed at the PCB masses, divided by the appropriate calibration factors. Thus the DL is a function of the TAGA response per unit ug/m3 and the variation in background signals.) Detection limits for total PCBs monitored (di- to penta-) for the individual days were 0.11 ug/m3 for July 28, and 0.15 ug/m3 for July 30. To calculate the DL it is necessary to perform daily calibrations. Calibrations were also randomly conducted throughout the day to confirm the daily sensitivity factors. The relative standard deviations were no greater than 5% for multiple injections of PCBs at the 0.425 ug/m3 level.

6.1.2 MAMU #2 (Chlorinated Organics)

The gas chromatograph in MAMU #2 was used to monitor the chlorinated organics and was calibrated daily with the technique outlined in section 2.0.

The detection limits were in the range of 0.3 to 5.0 ug/m3 for the monitored compounds which are listed in Table 8.

6.1.3 Survey Strategy

The survey strategy was to position the mobile TAGA unit downwind of the TOX incinerator, located in building #39 on the Dow property (See Fig 5). Ambient PCB levels were then recorded every 2 minutes and compared to the upwind, or background measurements.

The selection of sampling sites was subject to accessibility and meteorological conditions (wind speed and wind direction). Due to the fact that the plume was often visible, sampling locations were easily discerned. All of the sampling locations were on Dow Chemical Inc. property, roughly 200 to 300 metres from the source. There were times during this survey when the TOX plume impinged directly on the mobile unit, making it possible to collect and analyse air samples taken directly from the TOX plume.

6.2 Results and Discussion - MAMU #3 (PCBs)

A total of 15 30-minute average concentrations of selected PCBs was determined in the immediate vicinity of Dow's TOX incinerator. The 15 1/2-hour average concentrations represented 225 2-minute samples. Table #9 contains the PCB monitoring results, a summary of the meteorological conditions recorded by the TAGA meteorological station, comments and sampling locations. Figure #5 is a map detailing exact monitoring locations.

6.2.1 July 28

The mobile TAGA unit arrived at Dow Chemical Incorporated at 20:34 hours and commenced with the necessary preparations to conduct PCB monitoring. From 21:32 hours until 01:09 hours a total of five (5) 1/2-hour averaged concentrations for PCBs was determined. As may be seen in Table #9 PCBs were not detected in the air during any of the five 1/2-hour averages. In fact, at no time on this day were PCBs detected above the daily analytical detection limit of 0.11 ug/m3.

Sampling locations A-D represent the sites where the five 1/2-hour averages were collected on July 28. It is noteworthy that the plume was visible during all monitoring conducted on this day, and that while the unit was stationed at sites C and D the plume from the TOX stack actually impinged directly on the unit.

6.2.2 July 29

The fifth 1/2-hour average discussed above actually took place on July 29 (00:37 - 01:09 hours). At 13:30 hours the TAGA unit returned to Dow to continue monitoring. The unit was positioned upwind of the TOX stack in an attempt to measure background concentrations. Unfortunately a heavy rain adversely affected the sensitivity of the TAGA for measuring PCBs. There was no indication of the rain subsiding and the day's monitoring was cancelled at 16:00 hours.

6.2.3 July 30

Following calibrations, a 1/2-hour averaged background was determined at site E (See Fig #5). Throughout the acquisition of this sample there existed an odour which resembled rubber. Our sampling location and the predominant wind direction suggested the source of the odour to be Polysar, a neighbouring plant.

The TAGA unit was then repositioned downwind of the TOX stack, where a total of nine (9) 1/2-hour averages was determined. For the first four of these 1/2-hour averages (D7 - D10) the TOX stack was inoperative. However for the remaining 1/2-hour averages (D11 - D15) the TOX stack was operative and a plume was visible. PCBs were not detected in the air during any of these nine 1/2-hour sampling periods. Once again no PCBs were detected above the daily detection limit of 0.15 ug/m3.

6.3 MAMU #2 Results (Chlorinated Organics)

The sampling locations of MAMU #2 were usually adjacent to MAMU #3 since both units were monitoring the same source. Figure #6 shows the exact locations for the monitoring periods which are listed in Table #10.

Total concentrations of the chlorinated organics were in the range of 102 to 603 ug/m3 for the 11 half-hour samples collected downwind, with a mean value of 256 ug/m3. A single upwind sample gave 59 ug/m3. The results on the Dow Chemical Inc. property were noticeably higher than the results for the preceding study in the general area of Sarnia, where the range was from 9 to 118 ug/m3 with a mean downwind value of 51 ug/m3 and an upwind mean of 29 ug/m3.

Seven compounds were found to have significantly larger concentrations on the Dow Chemical Inc. property than during the general Sarnia air survey, and are marked with an asterisk (*) in Table 8. However, all concentrations were well below any applicable Ontario standards or guidelines.

6.4 Summary of Dow Survey

On July 28,29 and 30, 1986, the MAMUs #2 and 3 (TAGA 3000) of the Air Resources Branch conducted an air monitoring survey at the Dow Chemical Incorporated plant located in Sarnia. The survey objective was to provide on-site measurements of ambient PCBs and other chlorinated organics during the operation of the TOX (total oxidation) incinerator.

During the three days of monitoring a total of 225 2-minute air samples were screened for selected PCBs using the Ministry's TAGA unit. None of the 15 1/2-hour averaged concentrations for PCBs exceeded the Ministry guideline of 0.45 ug/m3 for a 1/2-hour average. In fact, all of the measurements for ambient air PCBs were below the TAGA's detection limits of 0.13 ug/m3 (average) for total PCBs.

The mean concentration of the total chlorinated organics measured by MAMU #2 was noticeably higher on the Dow property than in the general Sarnia area. Seven compounds in particular were noted, but none of the applicable Ontario standards or guidelines were exceeded.

Table 1

THE INSTRUMENTATION OF MOBILE AIR MONITORING UNIT #1

Instrument[1]	Manufacturer	Analytical Technique	Full Scale Sensitivity
THC, CH4, TH-M analyzer	Ingenieur-Produktions-Gruppe Munchen (IPM) RS-t	Dual flame ionization	50 ppm THC (as CH4)
H2S,SO2,NOx sources	Hartmann & Braun Prufgasgenerator	-	-
TRS/SO2 analyzer	Monitor Labs 8850 c/w ML 8770	Fluorescence	0.5 ppm SO2 0.5 ppm TRS
NOx, NO2, NO analyzer	Monitor Labs 8840	Chemi-Luminescence	1.0 ppm NOx (as NO2)
CO analyzer	Thermo Electron P48	Gas Filter Correlation	100 ppm CO (digital)
O3 analyzer/ source	Dasibi 1003-AAS	UV Absorption	1.0 ppm O3 (digital)
Hewlett Packard Data Acquisition System - HP 85 and HP 3497A			
Gas Chromatograph	HP 5880 Dual Capillary Column c/w HP 86 Data Acquisition System	Flame Ion-ization Det.	as set per calibrations

Meteorological Instrumentation

Instrument	Manufacturer	Scale
Wind speed **	Lambrecht GmBH	km/hr
Wind direction **	Lambrecht GmBH	degrees
Temperature	Weather Measure (WM) T621	degrees Celsius
Humidity	WM-HM-11P	% relative
Barometric pressure	WM-BM70-B242	millibars
Solar Radiation	WM Star Pyranometer	milliwatts/cm2

** These instruments are located on top of a 10 metre retractable tower

[1] Sources are used for daily calibration of the instruments.

Table 2

THE INSTRUMENTATION OF MOBILE AIR MONITORING UNIT #2

Instrument[1]	Manufacturer	Analytical Technique	Full Scale Sensitivity
THC, CH4, TH-M analyzer	Ingenieur-Produktions-Gruppe Munchen (IPM) RS-t	Dual flame ionization	50 ppm THC (as CH4)
H2S,SO2,NOx sources	Hartmann & Braun Prufgasgenerator	-	-
TRS analyzer	Monitor Labs 8850 c/w ML 8770	Fluorescence	0.5 ppm H2S
SO2 analyzer	Monitor Labs 8850	Fluorescence	0.5 ppm SO2
NOx, NO2, NO analyzer	Monitor Labs 8840	Chemi-Luminescence	1.0 ppm NOx (as NO2)
CO analyzer	Thermo Electron P48	Gas Filter Correlation	100 ppm CO (digital)
O3 analyzer/ source	Dasibi 1003-AAS	UV Absorption	1.0 ppm O3 (digital)
Hg analyzer	Scintrex HGP-2	UV Absorption	50 ug/m3
Hewlett Packard Data Acquisition System - HP 85 and HP 3497A			
Gas Chromatograph	HP 5880 Dual Capillary Column c/w HP 86 Data Acquisition System	Flame Ion-ization Det.	as set per calibrations

Meteorological Instrumentation

Instrument	Manufacturer	Scale
Wind speed **	Lambrecht GmBH	km/hr
Wind direction **	Lambrecht GmBH	degrees
Temperature	Weather Measure (WM) T621	degrees Celsius
Humidity	WM-HM-11P	% relative
Barometric pressure	WM-BM70-B242	millibars
Solar Radiation	WM Star Pyranometer	milliwatts/cm2

** These instruments are located on top of a 10 metre retractable tower

[1] Sources are used for daily calibration of the instruments.

Table #3: Loocations and Periods for MAMU #1

Monitoring Period #	Period[1]	Location	Map Site Fig. 1/2
A092	14:13-15:37	North of La Salle Road	A
A093	16:21-08:40	Water Treatment Plant (WTP) - Pt. Edward	B
A102	10:08-12:10	W.T.P.	B
A103	14:24-14:54	Moore Township - SE of Petrosar	Z
A142	10:55-13:11	W.T.P.	B
A143	14:23-08:44	Vidal Street	C
A152	10:09-13:30	Vidal Street	C
A153	14:59-07:37	W.T.P.	B
A162	09:04-10:15	W.T.P.	B
A163	12:12-14:13	Huron Blvd. and Tashmoo Ave.	D
A164	14:28-06:38	Vidal Street	C
A181	07:07-08:50	Vidal Street	C
A182	09:18-11:01	Plank Road and MacGregor Sideroad	E
A183	11:20-12:01	Vidal Street	C
A184	12:03-13:11	Vidal Street	C
A211	12:21-13:42	Best Western Hotel - Pt. Edward	F
A212	13:51-15:35	Parking Lot - West of Customs	G
A221	09:12-12:13	W.T.P.	B
A222	13:19-14:45	Hwy. #40B - One Mile South of Suncor	H
A231	12:05-16:39	W.T.P.	B
A232	16:39-13:27	W.T.P.	B
A241	13:53-17:34	Confederation Park	J

1. Each period starts on the date given in the period # by the second and third characters. For example, A143 was started on the 14th day of the month (July in this survey).

Table #4: Locations and Periods for MAMU #2

Monitoring Period #	Period[1]	Location	Map Site Fig. 1/2
B092	13:40-15:43	Chippewa Band Office	K
B104	12:52-13:27	La Salle Road and Hwy. #40	L
B105	13:52-14:30	Moore Township - SE of Petrosar	Z
B106	15:21-16:43	Yacht Club - Pt. Edward	B
B142	12:37-14:35	La Salle Road at Rail Crossing	M
B152	09:46-11:32	Indian Road at Water Tower	N
B153	12:06-13:41	Hwy. #40B - River Road	H
B156	15:36-16:08	Front St. - Centennial Park	J
B157	16:34-07:45	Indian Road	N
B162	08:32-09:52	Indian Road	N
B163	11:59-13:57	Chippewa Band Office	K
B172	09:03-15:32	Indian Road	N
B173	15:34-06:21	Indian Road	N
B181	06:23-12:38	Indian Road	N
B212	12:30-14:23	La Salle Road	P
B213	15:00-15:35	Hwy. #40B at Ethyl Corp. Park	Q
B214	15:54-16:34	Devine St. and Brock St.	R
B215	17:09-08:49	Indian Road	N
B222	10:56-13:03	London Road and Norman St.	S
B223	14:04-14:45	Hwy. #40B	H
B232	10:53-12:47	Indian Road	N
B233	13:24-14:21	Front St. - Centennial Park	J
B236	15:02-15:39	Best Western Hotel - Pt. Edward	F
B237	16:06-17:09	London Road and Norman St.	S
B242	10:01-11:04	London Road and Norman St.	S
B243	11:22-12:28	Wellington St. and Crawford St.	T
B244	13:35-14:08	Cameron St. - Church Lot.	U
B245	18:51-09:19	W.T.P.	B

1. Each period starts on the date given in the period # by the second and third characters. For example, A143 was started on the 14th day of the month (July in this survey).

TABLE #5

SARNIA SURVEY 1986
MONITORING RESULTS: MANU #3 (TAGA)

FP # (a)	DATE	MONITORING PERIOD	SITE (b)	MET CONDITIONS AT (c)	MET CONDITIONS WS (c)	MET CONDITIONS WD (c)	TENTATIVE ID (d)	EST. CONC. (e)	COMMENTS
1	09/07	14:45-15:23	A	22	15-25	N	Methanol Butanone Pentanone	1 10 5	Styrene odour and reduced sulphur odour
2	10/07	13:58-14:33	B	27	5-15	NW	Acetone Butylamine DMDS	5 5 15	Variable winds and no odour detected
3	14/07	12:47-13:29	C	25	0-15	NW	Ethanol Acetone DMDS	1 5 5	No odour detected
4	14/07	14:48-15:03	D	25	0-10	NNW	Ethanol Acetone	5 5	No odour detected
5	15/07	09:56-10:27	E	27	0-15	SW	NI		No odour detected
6	15/07	12:48-13:50	F	26	5-15	SSW	NI		No odour detected
7	15/07	14:04-14:35	G	29	0-15	SSW	NI		No odour detected
8	15/07	15:29-16:13	H	30	5-15	SW	NI		No odour detected

Notes: (a) FP # - Fingerprint Number
(b) See Figures 3,4 for monitoring locations
(c) Meteorological Conditions:
AT - Ambient Temperature (C)
WS - Range of Wind Speed (km/hr)
WD - Predominant Wind Direction
(d) Tentative Identification:
NI - No compounds identified
(e) Estimated Concentration (ug/m^3) +/- 3%

TABLE #5 (cont.)

SARNIA SURVEY 1986
MONITORING RESULTS: MANU #3 (TAGA)

FP # (a)	DATE	MONITORING PERIOD	SITE (b)	MET CONDITIONS AT (c)	MET CONDITIONS WS (c)	MET CONDITIONS WD (c)	TENTATIVE ID (d)	EST. CONC. (e)	COMMENTS
9	16/07	09:15-10:05	I	N/A	N/A	N/A	Methanol	5	No odour detected
10	16/07	11:58-12:41	J	25	0-10	W	Acetone	1	No odour detected
11	16/07	13:02-13:32	J	28	0-10	N	NI		
12	16/07	13:50-14:18	K	28	0-10	NE	NI		No odour detected
13	17/07	11:27-12:14	H	36	0-10	W	NI		No odour detected
14	17/07	14:29-14:39	L	36	5-20	W	NI		No odour detected
15	18/07	08:24-09:25	M	29	5-20	W	NI		Variable wind, no odour
16	18/07	09:37-10:37	M	30	5-20	W	NI		
17	18/07	12:24-12:38	K	34	10-25	SW	NI		No odour detected
18	21/07	14:02-14:33	M	23	10-25	NNE	NI		Light odour present
19	21/07	15:05-15:32	O	23	10-20	N	Acetone	1	No odour detected

Notes: (a) FP # - Fingerprint Number
(b) See Figures 3,4 for monitoring locations
(c) Meteorological Conditions:
AT - Ambient Temperature (C)
WS - Range of Wind Speed (km/hr)
WD - Predominant Wind Direction
(d) Tentative Identification:
NI - No compounds identified
(e) Estimated Concentration (ug/m^3) +/- 3X

TABLE #5 (cont.)

SARNIA SURVEY 1986
MONITORING RESULTS: MANU #3 (TAGA)

FP # (a)	DATE	MONITORING PERIOD	SITE (b)	MET CONDITIONS AT (c)	MET CONDITIONS WS (c)	MET CONDITIONS WD (c)	TENTATIVE ID (d)	EST. CONC. (e)	COMMENTS
20	22/07	10:03-10:33	P	24	5-10	SE	Acetone Butanone Pentanone	10 10 5	
21	22/07	11:15-12:02	Q	28	0-15	S	NI		No odour detected
22	22/07	12:07-12:50	Q	30	0-10	SW	Acetone Butanone Pentanone	5 5 5	
23	22/07	14:41-15:42	P	29	0-15	SW	NI		

Notes: (a) FP # - Fingerprint Number
(b) See Figures 3,4 for monitoring locations
(c) Meteorological Conditions:
AT - Ambient Temperature (C)
WS - Range of Wind Speed (km/hr)
WD - Predominant Wind Direction
(d) Tentative Identification:
NI - No compounds identified
(e) Estimated Concentration (ug/m^3) +/- 3%

Table 6. Maximum 1/2-hour average concentration (ppm, unless noted)

Area (Zone)	CO	THC	SO2	TRS	NO2	OZONE	TOC (ug/m³) mean	TOC (ug/m³) max
Vidal St., between Suncor plant and Confederation St.	2.0	6.9	0.27	0.008	0.11	0.10	578	1953
Sarnia, downtown	2.4	3.0	0.20	0.002	0.09	0.09	492	978
Point Edward	3.2	4.5	0.20	0.016	0.10	0.06	348	1742
Indian Rd S., south of tank farm & C.N.R. line	1.4	6.1	0.08	0.012	0.05	0.10	506	1930
Outside Sarnia, south of Suncor plant	4.5	3.4	0.10	0.030	0.07	0.05	456	919
Upwind - south side	1.4	2.8	0.05	0.003	0.04	0.09	332	555
Upwind - Point Edward	1.0	1.6	0.01	n.d.	0.01	0.06	83	320

TABLE 7

Summary of Main Organic Compounds - ($\mu g/m^3$) Measured in Sarnia Area, 1986

Compound	Vidal St.		Pt. Edward		Sarnia		Indian Rd.		Outside Sarnia		Upwind	
	mean	max	mean	max	mean	max	mean	max	mean	max	mean	max
Propane	38	100	6	21	14	35	24	64	52	343	2	5
Butane	60	145	39	168	64	134	148	1092	43	85	14	61
Pentane	32	215	29	158	41	94	30	258	34	99	14	50
Dichloromethane	n.d.	7	n.d.	n.d.	n.d.	n.d.	5	8	n.d.	4	n.d.	4
Hexane	23	71	15	87	28	57	26	129	22	61	8	34
1,1,1-trichloroethane	1	9	n.d.	n.d.	5	9	3	21	2	8	n.d.	n.d.
Benzene	76	450	4	19	15	39	40	284	30	178	18	104
Trichloroethene	n.d.	n.d.	n.d.	40	3	24	n.d.	8	1	8	n.d.	n.d.
Toluene	11	33	7	38	14	24	9	22	14	29	4	18
Tetrachloroethene	1	5	n.d.	n.d.	n.d.	2	n.d.	8	n.d.	2	n.d.	n.d.
Ethylbenzene	39	221	2	12	6	14	6	38	4	14	0.7	4
Xylenes	6	17	8	41	12	24	4	8	13	70	3	12
Total Organics	578	1953	348	1742	492	978	506	1930	456	919	154	555
Number of Samples	12		6		11		14		13		7	

Note: When a compound was detected only once, the mean was entered as n.d. (not detected)

Table 8. DOW CHLORINATED ORGANICS - JULY 1986 UG/M3

	30-minutes ending	1986 JUL 28 22:45	1986 JUL 28 23:47	1986 JUL 29 14:08	1986 JUL 29 15:25	1986 JUL 29 00:39	1986 JUL 30 14:09	1986 JUL 30 16:17	1986 JUL 30 17:17	1986 JUL 30 18:16	1986 JUL 30 19:19	1986 JUL 30 20:28	1986 JUL 30 21:28
	5 CHLOROMETHANE	89.89	35.72	28.02	28.75	41.03	27.56	34.38	30.86	32.12	26.13	20.49	18.96
*	8 CHLOROETHENE			3.91	3.57	7.4			5.23	6.35	3.97	6.84	1.11
	13 CHLOROETHANE		1.31	1.39					2.6				
*	21 DICHLOROMETHANE			91.21	4.38		41.62	19.49	43.63	14.77	13.53	12.54	8.16
	23 3-CHLOROPROPENE												2
	25 2-CHLORO-2-METHYLPROPANE												
	26 TRANS-1,2-DICHLOROETHENE												
	34 cis-1,2-DICHLOROETHENE												
	35 2-CHLOROBUTANE												
	37 TRICHLOROMETHANE												
	39 3-CHLORO-2-METHYLPROPENE												
*	41 1,2-DICHLOROETHANE	14.4	30.55	59.56	16.41	70.56	33.56		40.62	26.48	21.66	23.18	45.44
*	42 1,1,1-TRICHLOROETHANE	19.93	28.13	166.77	28.18	61.23	164.56	5.33	32.28	30.73	36.59	39.13	171.67
	43 1-CHLOROBUTANE												
*	45 TETRACHLOROMETHANE	35.66	26.45	32.82	9.23		135.35		8.1	7.97	5.12		153.26
*	52 1,2-DICHLOROPROPANE		2.66	75.19	2.49	91.8	136.04						202.67
	53 2,3-DICHLOROPROPENE												
	54 TRICHLOROETHENE			20.39	8.96		18.53					5.82	
	58 1-CHLORO-3-METHYLBUTANE												
	63 1-CHLOROPENTANE												
*	64 1,1,2-TRICHLOROETHANE						3.52				3.38	3.05	

Table 8. DOW CHLORINATED ORGANICS - JULY 1986 UG/M3

	1986 JUL 28	1986 JUL 28	1986 JUL 29	1986 JUL 29	1986 JUL 29	1986 JUL 30	1986 JUL 30	1986 JUL 30	1986 JUL 30	1986 JUL 30	1986 JUL 30	1986 JUL 30
30-minutes ending	22:45	23:47	14:08	15:25	00:39	14:09	16:17	17:17	18:16	19:19	20:28	21:28
66 1,3-DICHLOROPROPANE												
76 TETRACHLOROETHENE												
80 CHLOROBENZENE												
82 1-CHLOROHEXANE												
90 1,4-DICHLOROBUTANE												
91 1,1,2,2-TETRACHLOROETHANE												
94 1,2,3-TRICHLOROPROPANE												
95 TRANS-1,4-DICL-2-BUTENE												
98 2-CHLOROTOLUENE												
99 3-CHLOROTOLUENE												
101 4-CHLOROTOLUENE												
110 1,3-DICHLOROBENZENE	9.1	2.19										
112 (CHLOROMETHYL) BENZENE												
115 3-(CHLOROMETHYL) HEPTANE												
119 1,2-DICHLOROBENZENE												

• These compounds had larger concentrations on the Dow property than were found during the general Sarnia survey.

Table #9: TAGA PCB SURVEY - DOW CHEMICAL INC. (TOX INCINERATOR)
SARNIA JULY, 1986

S # (a)	DATE	START (b)	MET WS	MET WD (c)	MET AT	SITE (d)	1/2-Hr Conc. (e)	COMMENTS
D1	28/07	21:32	0-10	W	26	A	ND	DOWNWIND, VISIBLE PLUME, NO ODOUR
D2	28/07	22:04	15-30	NW	24	A	ND	DOWNWIND, VISIBLE PLUME, NO ODOUR
D3	28/07	23:10	10-15	NNW	23	B	ND	DOWNWIND, PLUME IMPINGING AT TAGA
D4	28/07	23:54	5-15	NW	22	C	ND	DOWNWIND, VISIBLE PLUME, IMPINGING
D5	29/07	00:37	5-15	NNW	21	D	ND	DOWNWIND, VISIBLE PLUME, IMPINGING
D6	30/07	13:23	15-25	NE	30	E	ND	BACKGROUND, UPWIND, POLYSAR ODOURS
D7	30/07	16:02	10-20	NNE	29	F	ND	DOWNWIND, INCINERATOR NOT OPERATIONAL
D8	30/07	16:34	10-20	NNE	29	F	ND	DOWNWIND, INCINERATOR NOT OPERATIONAL
D9	30/07	17:06	10-20	NNE	28	F	ND	DOWNWIND, INCINERATOR NOT OPERATIONAL
D10	30/07	17:38	10-20	NNE	27	F	ND	DOWNWIND, INCINERATOR NOT OPERATIONAL
D11	30/07	18:27	10-20	NE	26	F	ND	INCINERATOR OPERATIVE, VISIBLE PLUME
D12	30/07	18:51	5-20	NE	25	F	ND	INCINERATOR OPERATIVE, VISIBLE PLUME
D13	30/07	19:31	5-20	NNE	24	F	ND	INCINERATOR OPERATIVE, VISIBLE PLUME
D14	30/07	20:04	5-15	N	23	F	ND	INCINERATOR OPERATIVE, VISIBLE PLUME
D15	30/07	20:36	5-10	N	22	F	ND	INCINERATOR OPERATIVE, VISIBLE PLUME

Note: (a) S # - Refers to Sample #.
(b) Start Time refers to the adsorb time of the first sample.
(c) Meteorological conditions - WS = Range of Wind Speed (km/hr); WD = Predominant Wind Direction; AT = Ambient Temperature (°C).
(d) All monitoring locations are on Dow property (See Figure #5).
(e) 1/2-Hour Conc. = average of 15, 2-minute samples; sum of the di- to pentachlorobiphenyls; ND = Not Detected above detection limit. (0.11 ug/m^3 for July 8,29; 0.15 ug/m^3 for July 30).

Table 10. Monitoring Periods for MAMU #2 at Dow

Monitoring Period #	Period	Location	Map site Figure 6
B282	22:06-22:42	Dow, east of TOX	G
B283	22:50-00:35	Dow, SE of TOX	H
B292	13:27-15:15	Dow parking lot E of gate	J
B302	13:29-15:04	2nd St (#64)	K
B303	15:23-16:06	1st St, N of TOX	L
B304	16:18-21:18	Lot behind cafeteria	M

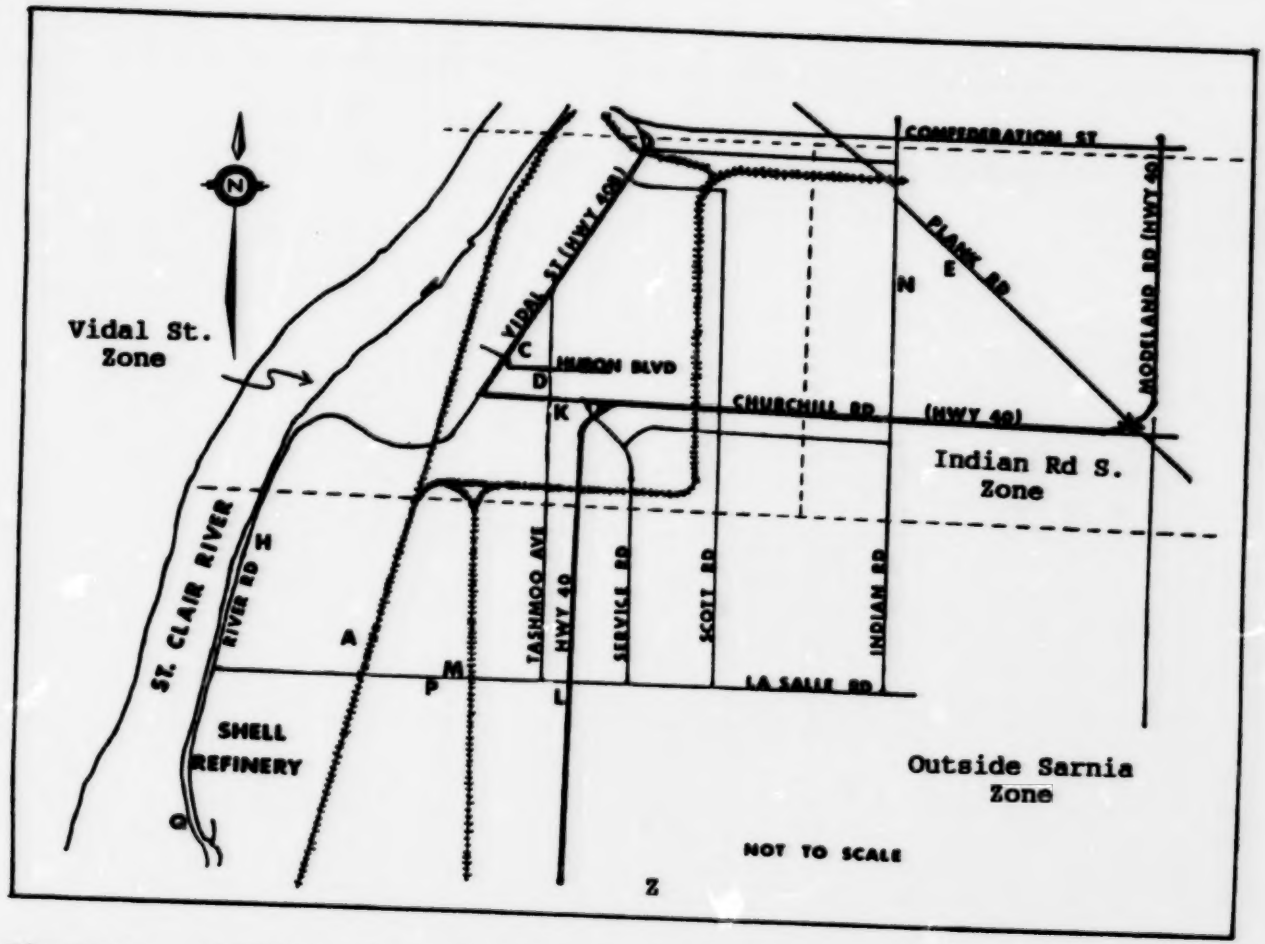

Figure 1. Locations for MAMUs 1 and 2 in southern sections of Sarnia area. See Tables 3 and 4. Zone Boundaries are shown by dashed lines. (--)

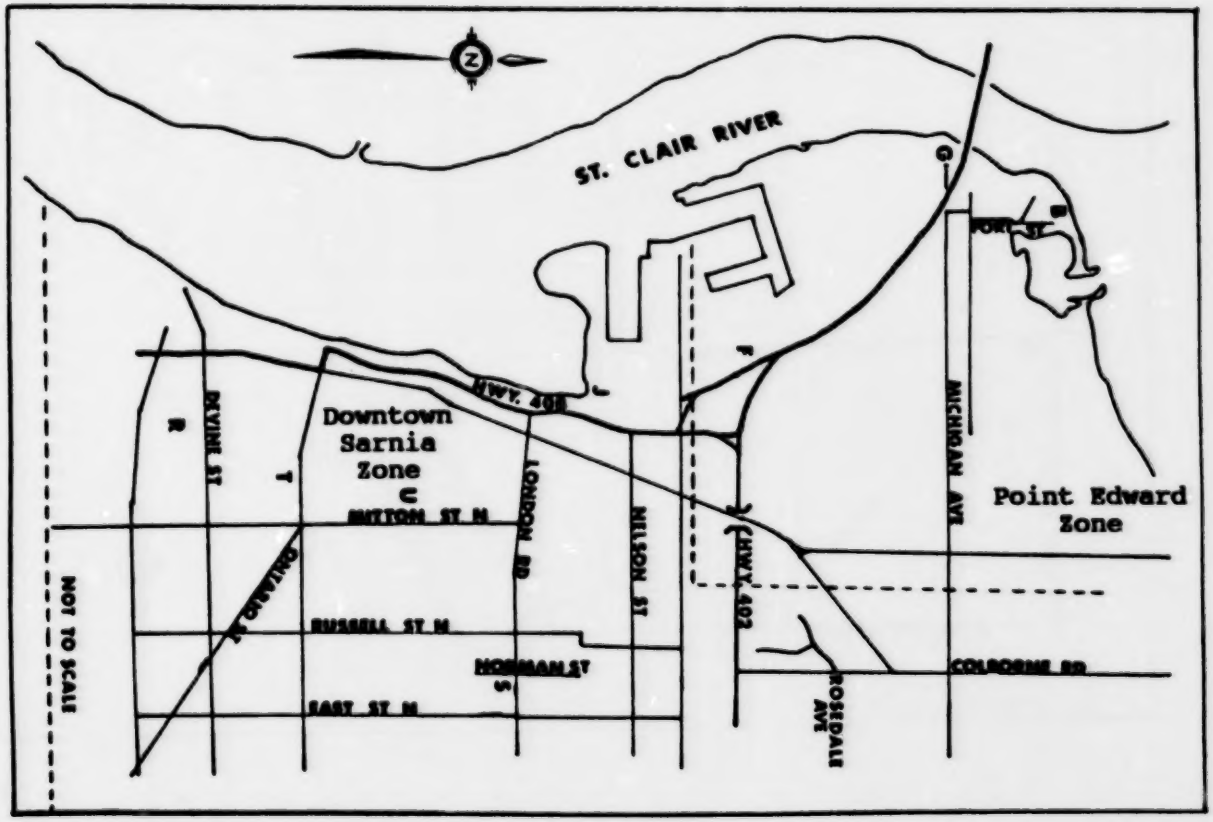

Figure 2. Locations for MAMUs 1 and 2 in downtown Sarnia and Point Edward. See Tables 3 and 4. Zone boundaries are shown by dashed lines (--)

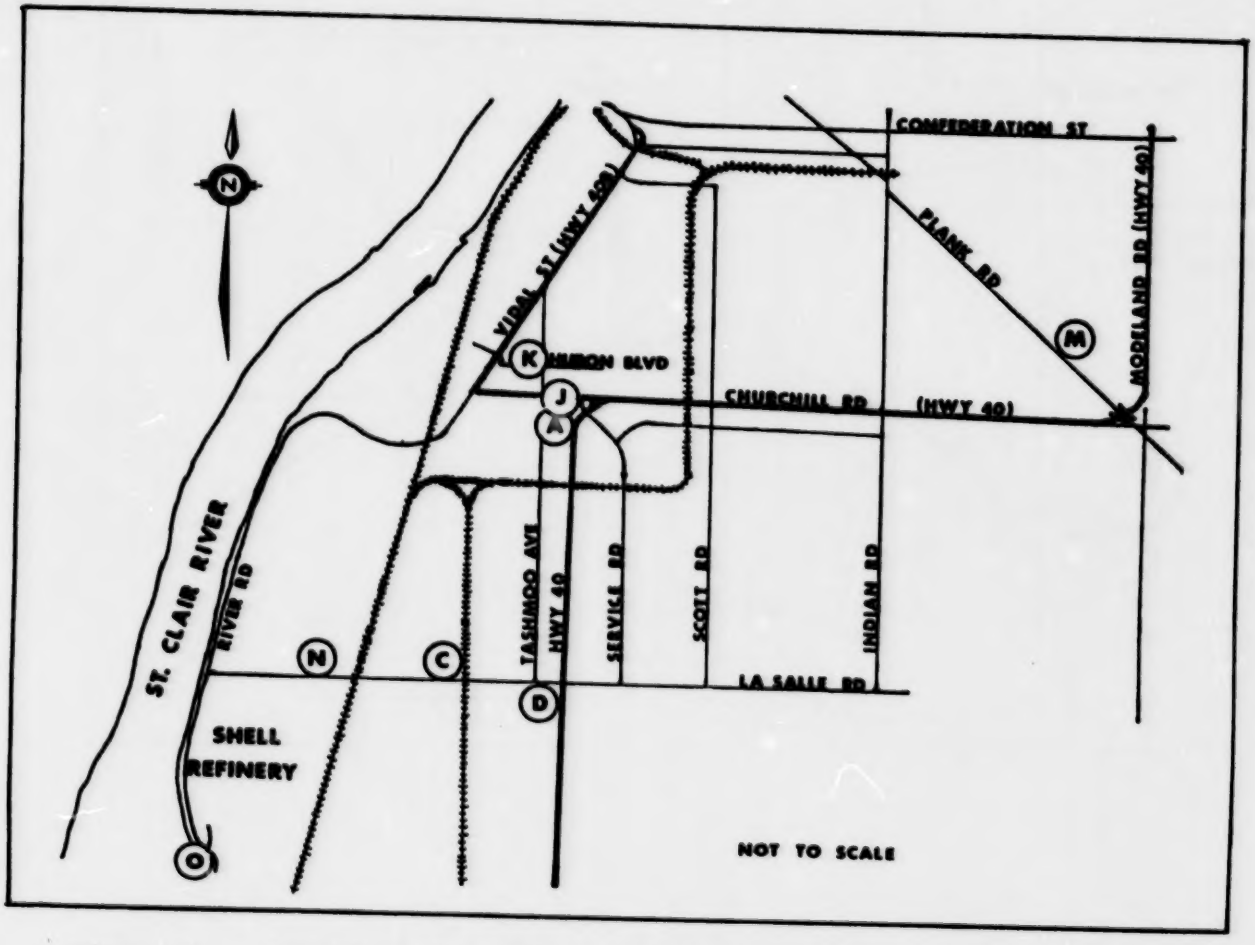

Figure 3. Locations for MAMU 3 (TAGA) in southern sections of Sarnia See Table 5.

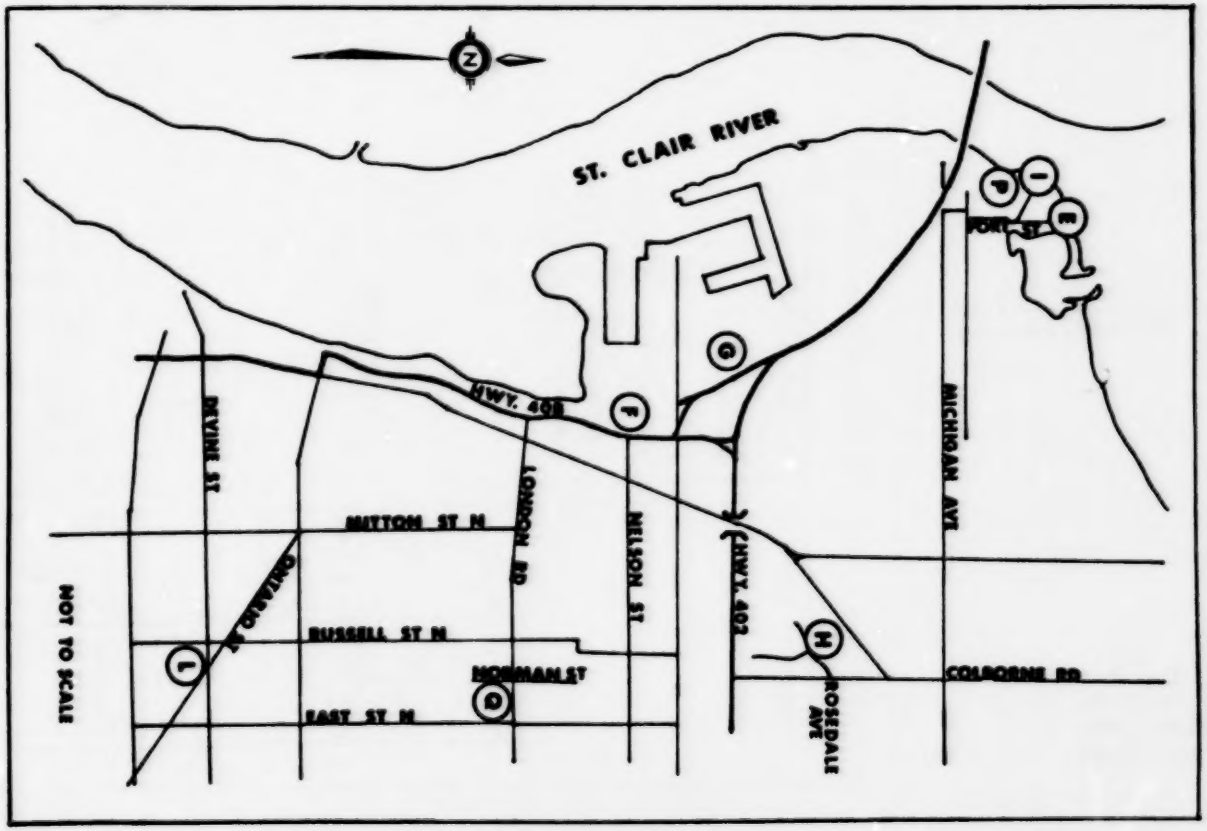

Figure 4. Locations for MAMU 3 (TAGA) in downtown Sarnia and Point Edward. See Table 5.

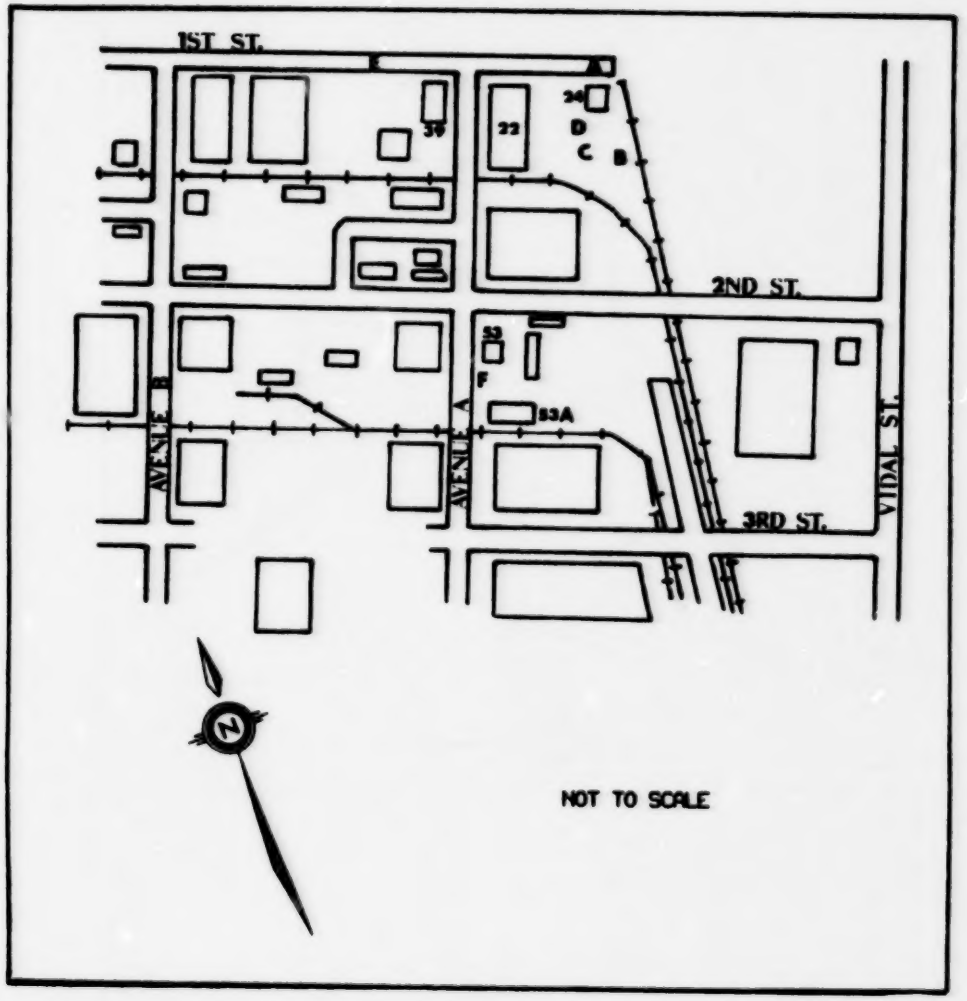

Figure 5. TAGA Monitoring Location
Dow Chemical Inc.
Sarnia, July, 1986.
See Table 9.

Sampling Location	Sample #
A	D1/D2
B	D3
C	D4
D	D5
E	D6
F	D7-D15

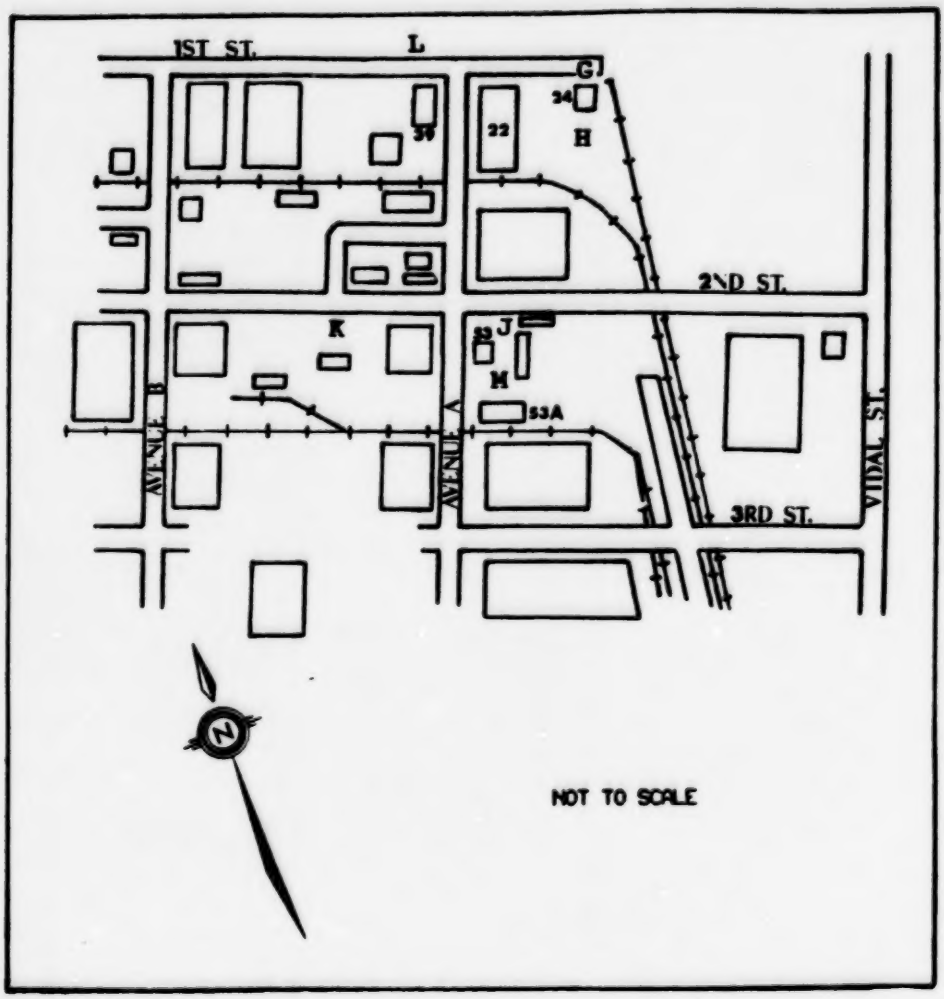

Figure 6. MAMU #2 Locations on Dow Property. See Table 10.

APPENDIX 1

Characteristics of the Common Contaminants as Measured Continuously by MAMU's #1 and #2

All concentrations are in terms of ppm (parts per million)

	Detection Limits	Standards, Guidelines or Provisional Guidelines (1/2 hr)		Criterion (1 hr)	TWA	STEL		Alternate Names	
1 SULPHUR DIOXIDE	0.005	0.300	(S)	0.25	2	5		SO2	SULFUR DIOXIDE
2 TOTAL REDUCED SULPHUR	0.005	0.027 *	(P)	0.027	10	15	**	TRS	
3 NITROGEN OXIDES	0.01	0.25 ***	(S)	N/A	-	-		NOx	OXIDES of NITROGEN
4 NITROGEN DIOXIDE	0.01	N/A		0.20	5	5		NO2	
5 NITRIC OXIDE	0.01	N/A		N/A	25	35		NO	NITROGEN MONOXIDE
6 OZONE	0.01	0.1	(S)	0.08	0.1	0.3		O3	
7 CARBON MONOXIDE	0.1	5.0	(S)	30.0	50	400		CO	

* As equivalent H2S and applicable only for Kraft Pulp Mills
TRS may contain any of the following: Hydrogen Sulphide (H2S), Methyl Mercaptan (CH3SH), Dimethyl Sulphide (C2H6S) and Dimethyl Disulphide (C2H6S2).
** The TWA and STEL for TRS is expressed solely for Hydrogen Sulphide concentrations
*** Expressed as NO2

S = Standard; G = Guideline; P = Provisional Guideline

Characteristics of the Organics Measured by the Gas Chromatographic Systems of MAMU #2

All concentrations are in terms of ug/m³ (micrograms per cubic metre)

	Detection Limits	Standards, Guidelines or Provisional Guidelines	Criterion	TWA	STEL	Alternate Names	
1 PROPANE	0.2						
2 PROPADIENE	0.3					ALLENE	
3 PROPYNE	0.3					METHYL ACETYLENE	
4 CHLOROMETHANE	0.3	20000 (2)	7000 (A)	105000	205000	METHYL CHLORIDE	
5 CYCLOPROPANE	0.3						
6 2-METHYLPROPANE	0.3					ISOBUTANE	
7 CHLOROETHENE	0.3	560 (2)	280 (A)	5000	10000	VINYL CHLORIDE; CHLOROETHYLENE	
~~8 2-CHLORO-2METHYLPROPANE~~	~~0.3~~						**
9 1-BUTENE	0.3						
10 1,3-BUTADIENE	0.3						
11 BUTANE	0.2			1900000		*n-BUTANE*	
12 1-BUTYNE	0.3					ETHYLACETYLENE	
13 CHLOROETHANE	0.3			2600000	3250000	ETHYL CHLORIDE	
14 3-METHYL-1-BUTENE	0.3					ISOAMYLENE	
15 2-METHYLBUTANE	0.3					ISOPENTANE	
~~16 2-METHYL-1-BUTENE~~	~~0.3~~						
17 PENTANE	0.2			1800000	2250000	*N-PENTANE*	
18 2-METHYL-1,3-BUTADIENE	0.4					ISOPRENE	
19 trans-2-PENTENE	0.2						
20 cis-2-PENTENE	0.2						
21 DICHLOROMETHANE	1.5	100000 (1)	100000 (B)	350000	1740000	METHYLENE CHLORIDE	

22 2-METHYL-2-BUTENE	0.3					
23 2,2-DIMETHYLBUTANE	0.2					NEOHEXANE
24 trans-1,2-DICHLOROETHENE	0.3					
25 3-METHYL-1-PENTENE	0.2					
26 4-METHYL-1-PENTENE	0.2					
27 CYCLOPENTANE	0.2					
28 2,3-DIMETHYLBUTANE	0.2					
29 2-METHYLPENTANE	0.2					
30 3-METHYLPENTANE	0.2					
31 1-HEXENE	0.3					
32 cis-1,2-DICHLOROETHENE	0.3					
33 2-CHLOROBUTANE	0.6				790000 1000000	cis-1,2-DICHLOROETHYLENE; SYM-DICHLOROETHYLENE
34 1-CHLORO-2-METHYLPROPANE	0.4					sec-BUTYL CHLORIDE
35 HEXANE	0.3	35000 (2)			180000	
36 CHLOROFORM	2.2	1500 (2)	500 (A)	50000	225000	"n-HEXANE"
37 trans-3-HEXENE	0.3					TRICHLOROMETHANE
38 3-CHLORO-2-METHYLPROPENE	0.3					
39 METHYLCYCLOPENTANE	0.2					ISOBUTENYL CHLORIDE
40 2,4-DIMETHYLPENTANE	0.2					
41 1,2-DICHLOROETHANE	0.2					
42 2,2-DIMETHYLPENTANE	0.4				40000 60000	ETHYLENE CHLORIDE
43 2,2,3-TRIMETHYLBUTANE	0.2					
44 1,1,1-TRICHLOROETHANE	1.0	350000 (1)	115000 (A)	19000000	2450000	METHYL CHLOROFORM
45 1-CHLOROBUTANE	0.4					n-BUTYL CHLORIDE
46 BENZENE	0.2	10000 (1)	3300 (A)	30000	75000	
47 TETRACHLOROMETHANE	0.9	1800 (2)	600 (A)	20000	125000	CARBON TETRACHLORIDE
48 3,3-DIMETHYLPENTANE	0.2					
49 CYCLOHEXANE	0.2	300000 (2)	100000 (A)	1050000	1300000	HEXAHYDROBENZENE
50 2,3-DIMETHYLPENTANE	0.3					
51 2-METHYLHEXANE	0.5					
52 CYCLOHEXENE	0.3					ISOHEPTANE
53 DIBROMOMETHANE	18.4			1015000		
54 1,2-DICHLOROPROPANE	0.6					METHYLENE DIBROMIDE; METHYLENE BROMIDE
55 3-METHYLHEXANE	0.5					PROPYLENE CHLORIDE
56 2,3-DICHLOROPROPENE	0.7					
57 TRICHLOROETHENE	0.3	85000 (1)	28000 (A)	5000	50000	2,3-DICHLOROPROPYLENE
				270000	1080000	TRICHLOROETHYLENE

58 2,2,4-TRIMETHYLPENTANE	0.2					ISOOCTANE
59 1-HEPTENE	0.3					
60 HEPTANE	0.2			1600000	2000000	*n-HEPTANE*
61 trans-2-HEPTENE	0.3					
62 METHYLCYCLOHEXANE	0.2			1600000	2000000	HEXAHYDROTOLUENE
63 2,2-DIMETHYLHEXANE	0.2					
64 ETHYLCYCLOPENTANE	0.2					
65 4-METHYLCYCLOHEXENE	0.3					
66 2,5-DIMETHYLHEXANE	0.5					
67 1-CHLOROPENTANE	0.4					n-AMYL CHLORIDE; PENTYL CHLORIDE
68 1,1,2-TRICHLOROETHANE	1.1					VINYL TRICHLORIDE
69 2,3,4-TRIMETHYLPENTANE	0.2					
70 TOLUENE	0.2	2000 (1)	2000 (A)	375000	560000	*METHYLBENZENE*; PHENYLMETHANE
71 1,3-DICHLOROPROPANE	0.7			350000	510000	TRIMETHYLENE CHLORIDE
72 2-METHYLHEPTANE	0.2					
73 4-METHYLHEPTANE	0.2					
74 c-1,3-DIMETHYLCYCLOHEXANE	0.2					
75 3-METHYLHEPTANE	0.2					
76 1,2-DIBROMOETHANE	2.1					ETHYLENE DIBROMIDE; ETHYLENE BROMIDE
77 1,1-DIMETHYLCYCLOHEXANE	0.3					
78 1-OCTENE	0.4	150000 (3)	50000 (A)			
79 trans12DIMETHYLCYCLOHEXANE	0.3					*trans-1,2-DIMETHYLCYCLOHEXANE
80 trans-4-OCTENE	0.3					
81 TETRACHLOROETHENE	0.9			335000	1340000	TETRACHLOROETHYLENE; PERCHLOROETHYLENE
82 c-1,4-DIMETHYLCYCLOHEXANE	0.3					
83 OCTANE	0.3			1450000	1800000	*n-OCTANE*
84 trans-2-OCTENE	0.6					
85 cis12DIMETHYLCYCLOHEXANE	0.2					
86 CHLOROBENZENE	0.4			350000		PHENYL CHLORIDE
87 ETHYLCYCLOHEXANE	0.1					
88 1-CHLOROHEXANE	0.5					n-HEXYL CHLORIDE
89 ETHYLBENZENE	0.3	4000 (1)	4000 (A)	435000	545000	
90 m-XYLENE	0.3	2300 (4)	2300 (A)	435000	655000	*1,3-DIMETHYLBENZENE*
91 p-XYLENE	0.3	2300 (4)	2300 (A)	435000	655000	*1,4-DIMETHYLBENZENE*
92 4-METHYLOCTANE	0.3					
93 2-METHYLOCTANE	0.3					

94 3-METHYLOCTANE	0.3					
95 STYRENE	0.5	400 (1)	400 (A)	215000	425000	*ETHENYLBENZENE*; PHENYLETHYLENE; VINYLBENZENE
96 1,4-DICHLOROBUTANE	0.3					
97 o-XYLENE	0.3	2300 (4)	2300 (A)	435000	655000	*1,2-DIMETHYLBENZENE*
98 1,1,2,2-TETRACHLOROETHANE	2.6					ACETYLENE TETRACHLORIDE
99 1,2,3-TRICHLOROPROPANE	1.3			300000	450000	TRICHLOROHYDRIN
100 1-NONENE	0.7					
101 trans-1,4-DICL-2-BUTENE	0.9					
102 NONANE	0.3			1050000	1300000	*n-NONANE*
103 ISOPROPYLBENZENE	0.3	100 (3)	100 (B)			*(1-METHYLETHYL)BENZENE*; CUMENE
104 2-CHLOROTOLUENE	0.3					*2-CHLORO-1-METHYLBENZENE*; o-TOLYL CHLORIDE; o-CHLOROTOLUENE
105 3-CHLOROTOLUENE	0.5					*3-CHLORO-1-METHYLBENZENE*; m-TOLYL CHLORIDE; m-CHLOROTOLUENE
106 4-CHLOROTOLUENE	0.5					*4-CHLORO-1-METHYLBENZENE; p-TOLYL CHLORIDE; p-CHLOROTOLUENE
107 PROPYLBENZENE	0.4					n-PROPYLBENZENE
108 3-ETHYLTOLUENE	0.3					*1-ETHYL-3-METHYLBENZENE*; M-ETHYLTOLUENE
109 4-ETHYLTOLUENE	0.3					*1-ETHYL-4-METHYLBENZENE*; P-ETHYLTOLUENE
110 1,3,5-TRIMETHYLBENZENE	0.4			125000	170000	MESITYLENE
111 2-ETHYLTOLUENE	0.3					*1-ETHYL-2-METHYLBENZENE*; O-ETHYLTOLUENE
112 1,2,4-TRIMETHYLBENZENE	0.4	100 (1)	1000 (A)	125000	170000	PSUEDOCUMENE
113 tert.BUTYLBENZENE	0.3					*(1,1-DIMETHYLETHYL)BENZENE*
114 tert.BUTYLCYCLOHEXANE	0.4					
115 1,3-DICHLOROBENZENE	0.8					
116 1-DECENE	1.3	100000 (3)	60000 (A)			n-DECYLENE
117 (CHLOROMETHYL)BENZENE	4.3					alpha-CHLOROTOLUENE; BENZYL CHLORIDE
118 1,5-DICHLOROPENTANE	0.3					
119 isoBUTYLBENZENE	0.3					
120 DECANE	0.5					*n-DECANE*
121 sec.BUTYLBENZENE	0.2					*(1-METHYLPROPYL)BENZENE*
122 3-(CHLOROMETHYL)HEPTANE	0.3					
123 1,2,3-TRIMETHYLBENZENE	0.4			125000	175000	HEMIMELLITENE
124 1ISOPROPYL4METHYLBENZENE	0.5					*METHYL(4-METHYLETHYL)BENZENE*; 3-ISOPROPYLTOLUENE; P-CYMENE
125 1,2-DICHLOROBENZENE	0.3					o-DICHLOROBENZENE
126 INDAN	0.5					*2,3-DIHYDRO-1H-INDENE*; 2,3-DIHYDROINDENE; HYDRINDENE
127 BUTYLCYCLOHEXANE	0.4					n-BUTYLCYCLOHEXANE; 1-CYCLOHEXYLBUTANE
128 1,3-DIETHYLBENZENE	0.4					m-DIETHYLBENZENE
129 1,4-DIETHYLBENZENE	0.5					p-DIETHYLBENZENE

130	BUTYLBENZENE	0.3			n-BUTYLBENZENE
131	1,2-DIETHYLBENZENE	0.5			o-DIETHYLBENZENE
132	transDECAHYDRONAPHTHALENE	0.3			t-DECALIN: BICYCLO[4,4,0]DECANE
133	cis-DECAHYDRONAPHTHALENE	0.3			c-DECALIN: BICYCLO[4,4,0]DECANE
134	UNDECANE	0.8			*n-UNDECANE*; HENDECANE
135	1235-TETRAMETHYLBENZENE	0.6			ISODURENE
136	1234-TETRAMETHYLBENZENE	0.6			PREHNITENE
~~137~~	~~1,3-DIISOPROPYLBENZENE~~	~~0.8~~			~~*1,3-BIS(1-METHYLETHYL)BENZENE*~~
138	1234TETRAHYDRONAPHTHALENE	0.6			TETRALIN
139	1,4-DIISOPROPYLBENZENE	0.8			*1,4-BIS(1-METHYLETHYL)BENZENE*; ISOPROPYLCUMENE
~~140~~	~~NAPHTHALENE~~	~~0.8~~	~~36 (3)~~	~~22.5 (A)~~	
141	DODECANE	1.3			*n-DODECANE*

NOTES:
(1) Standard
(2) Guideline
(3) Provisional Guideline
(4) Provisional Guideline for sum of o-, m-, & p-Xylenes

(A) Ambient Air Quality Criterion based on a 24-hour average concentration
(B) Ambient Air Quality Criterion based on a 1-hour average concentration
(please note; if the maximum 1-hour average concentration of a contaminant is LESS than the Criterion concentration based on a 24-hour average, then that Criterion has NOT been exceeded.)

TWA - Time Weighted Average for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed without adverse effect.

STEL - Short Term Exposure Limit - concentration to which workers can be exposed for a short period of time (15 minutes) without adverse effect.

* - Denotes name approved by the International Union of Pure and Applied Chemistry (IUPAC).

** Compounds which are stroked through (——) were not monitored during this survey.